

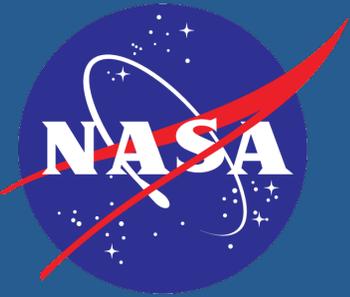
**A regional survey of UT/LS cirrus cloud  
distribution, microphysical characteristics,  
optical depth and ice water content from  
CALIPSO during SEAC4RS**

Melody Avery

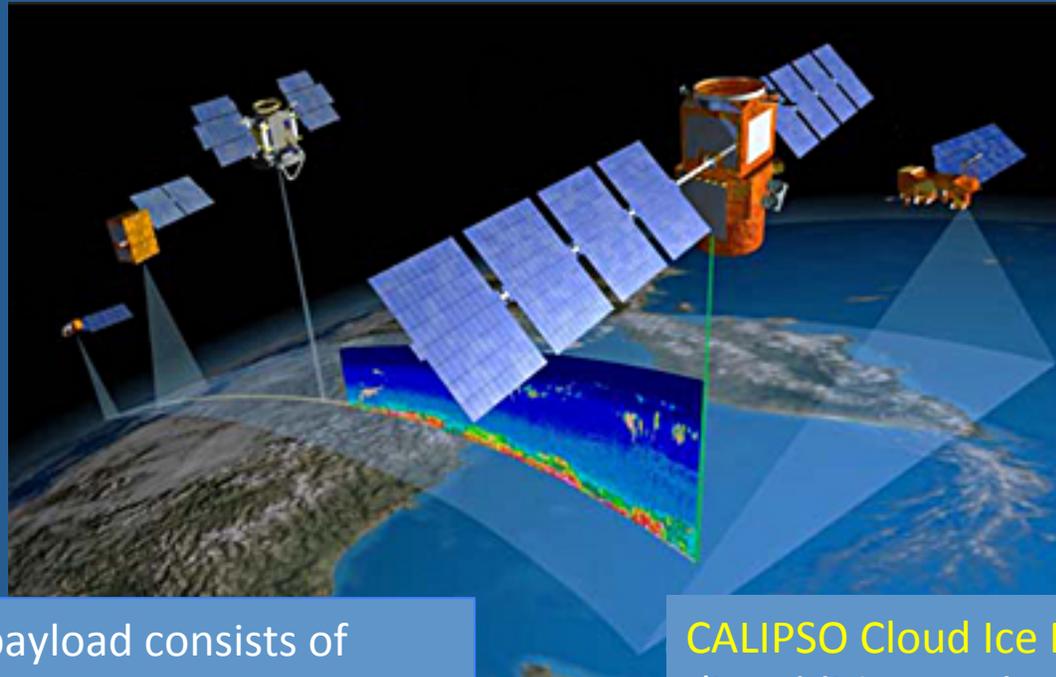
SEAC4RS Science Team Meeting

April, 2014

Collaborators: Paul Lawson, Sara Lance, Sarah Woods, John  
Yorks, Matt McGill, Mark Vaughan, Dave Winker, Chip  
Trepte, David Mitchell, Anne Garnier



# CALIOP on CALIPSO



The CALIPSO payload consists of three co-aligned nadir-viewing instruments:

- Cloud-Aerosol Lidar with Orthogonal Polarization (**CALIOP**)
- Imaging Infrared Radiometer (**IIR**)
- Wide Field Camera (**WFC**)

**Operational since June, 2006**

## **CALIPSO Cloud Ice Products:**

(in addition to cloud top height and cloud fraction...)

- CALIOP Ice Water Content (IWC)
- CALIOP Ice Water Path (IWP)
- CALIOP Extinction
- CALIOP Optical Depth (OD)
- IIR Ice Water Path (IWP)
- IIR Optical Depth (OD)
- IIR Effective Diameter
- IIR Microphysical Parameter

Question: Can a space-based elastic backscatter lidar and coincident infrared radiometer recognize the varied microphysical properties observed by aircraft-based cloud probes in cirrus clouds?

SEAC4RS provides an ideal data set to answer this question:

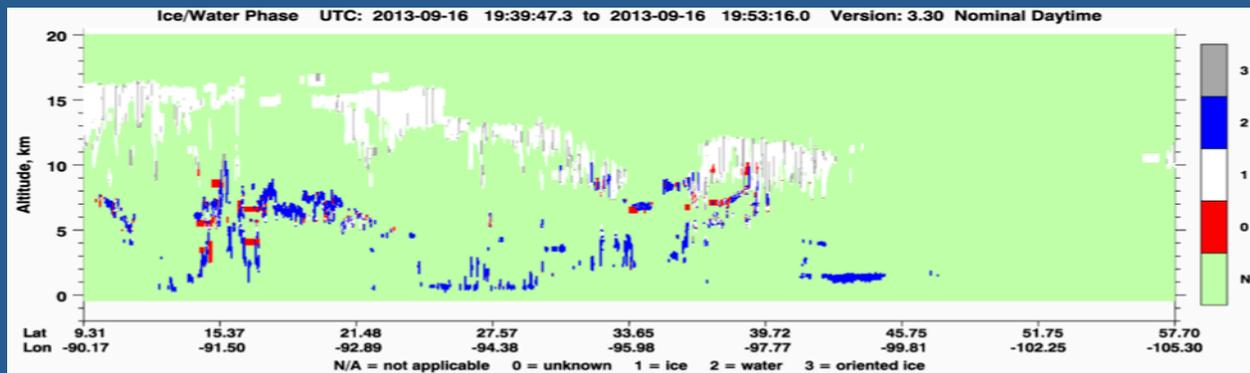
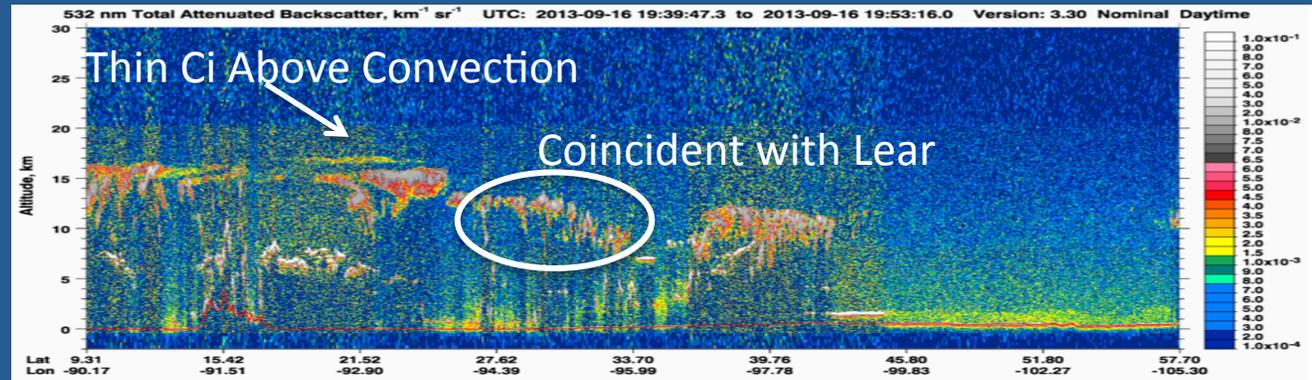
UT/LS studies, smoky clouds, continental convection, marine tropical convection

Today - Progress Report Using CALIOP Parameters:

- 532 nm layer-integrated backscatter
- 532 nm layer-integrated depolarization
- 1064 nm/532 nm layer backscatter ratio

# Example of CALIOP Daytime Data - 0916

CALIPSO Overpass –  
532 nm Attenuated  
Backscatter  
Coefficient Profiles

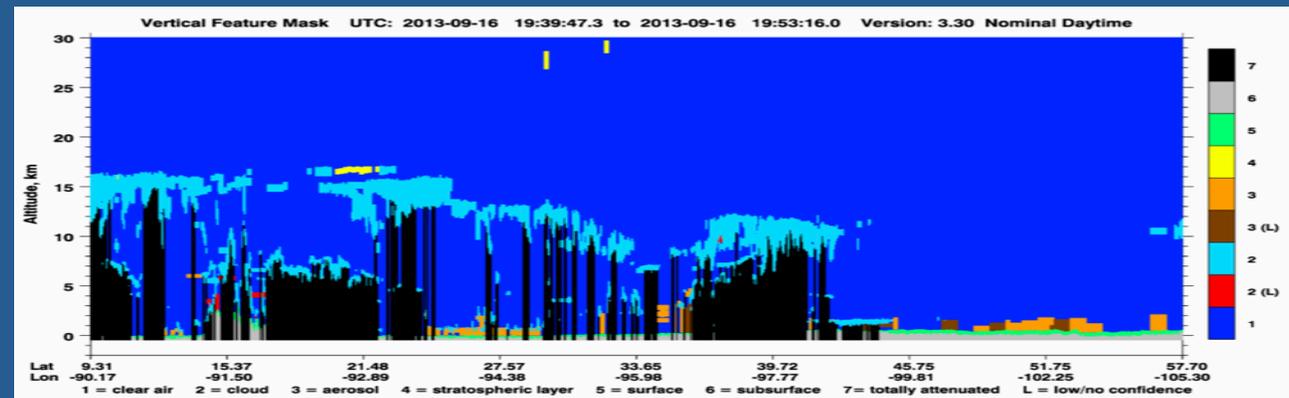


Cloud Phase  
Assignment

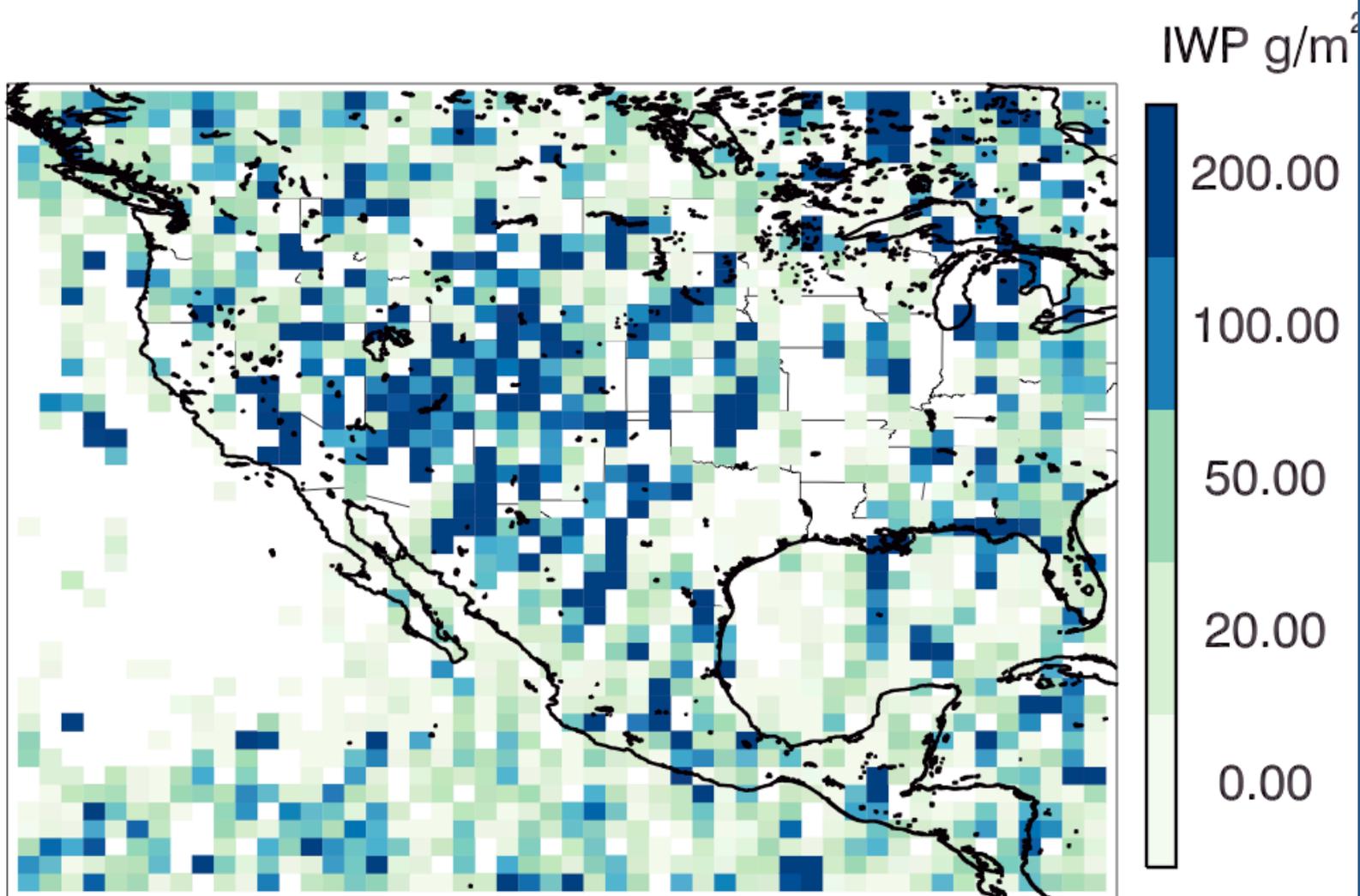
White, Grey = Ice  
Blue = Water  
Red = Not sure

Vertical Feature Mask

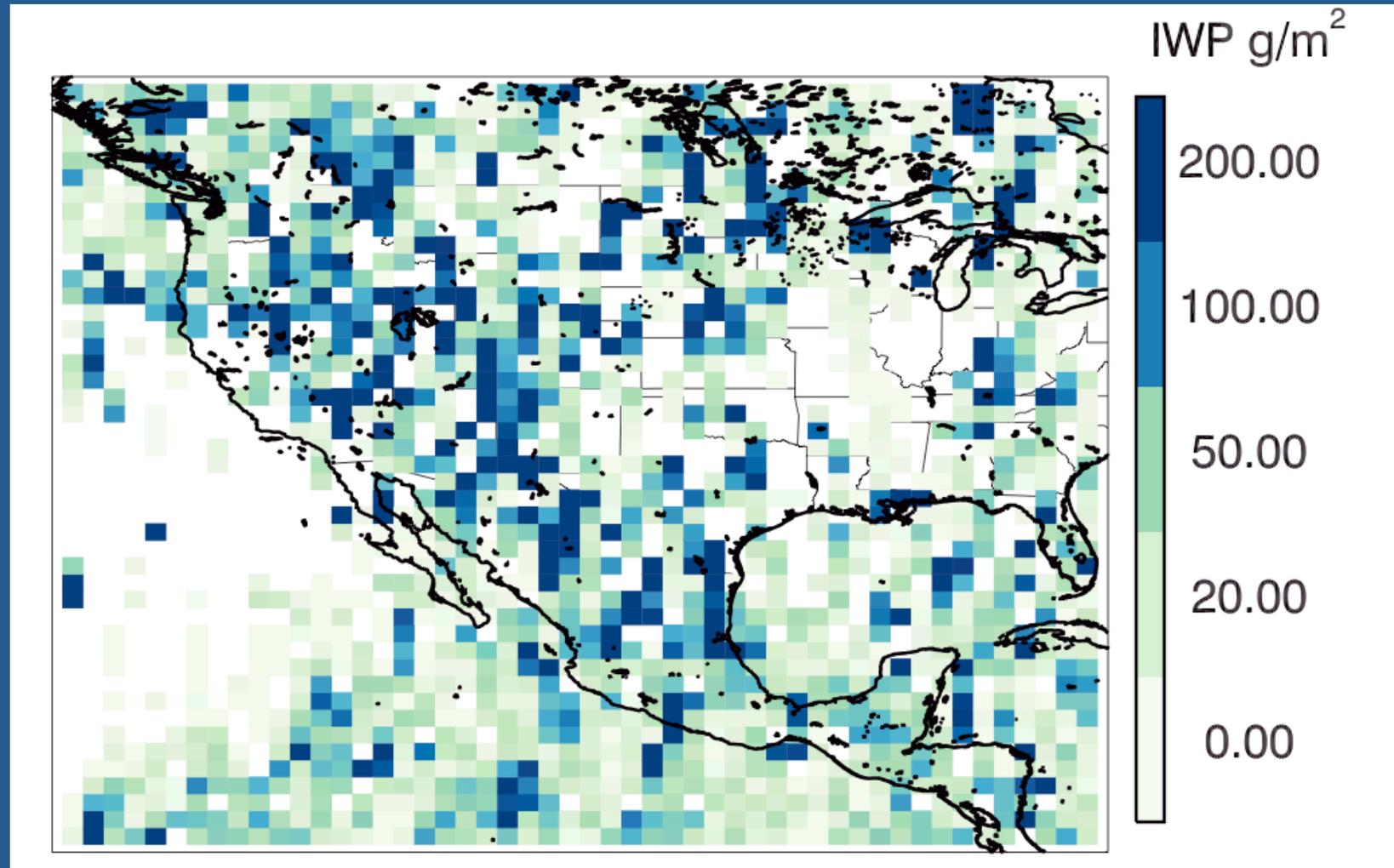
Blue = Clouds  
Yellow = Stratosphere  
Orange = Aerosol



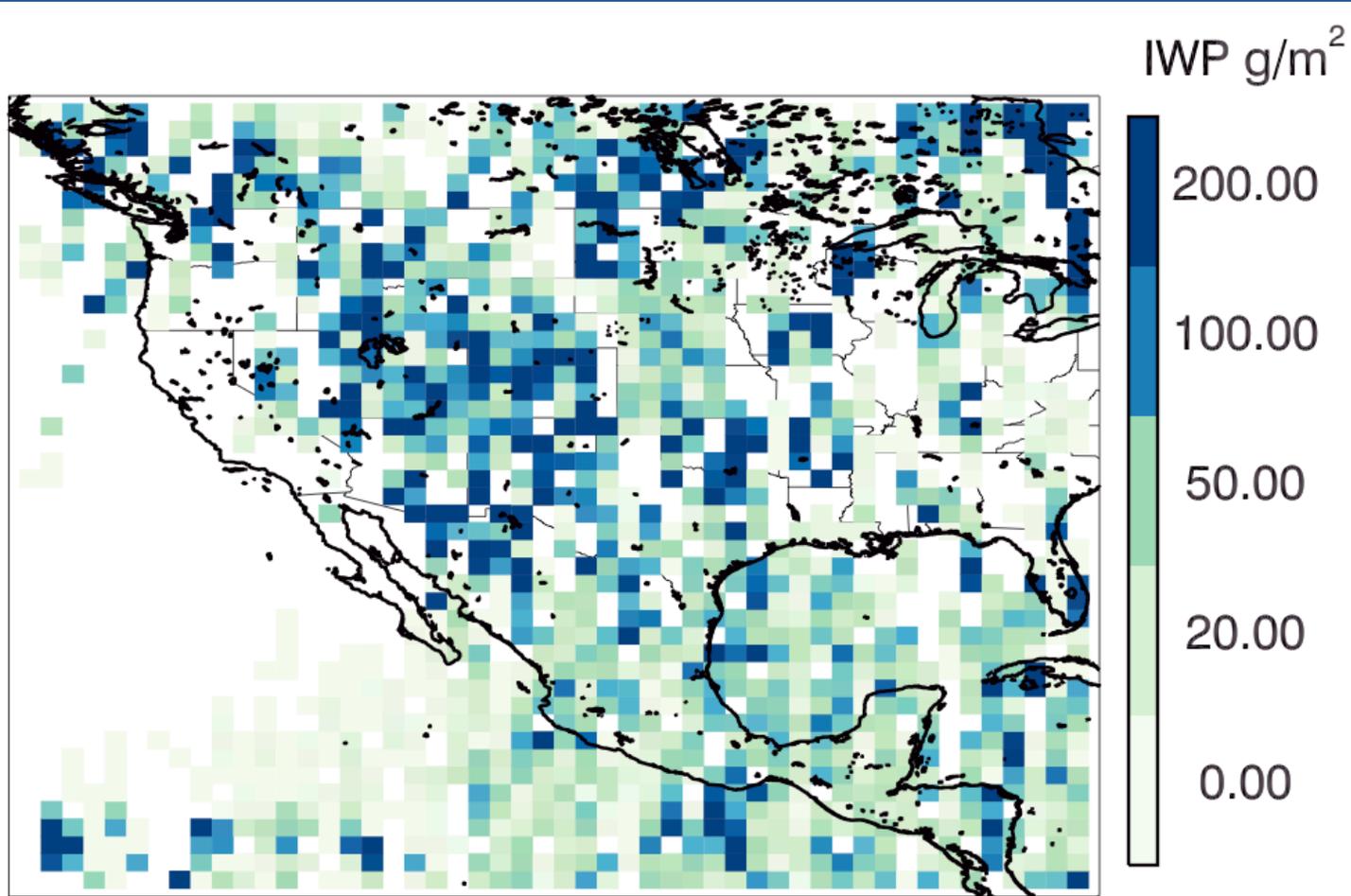
# CALIOP Ice Water Path August 6 – August 21, 2013



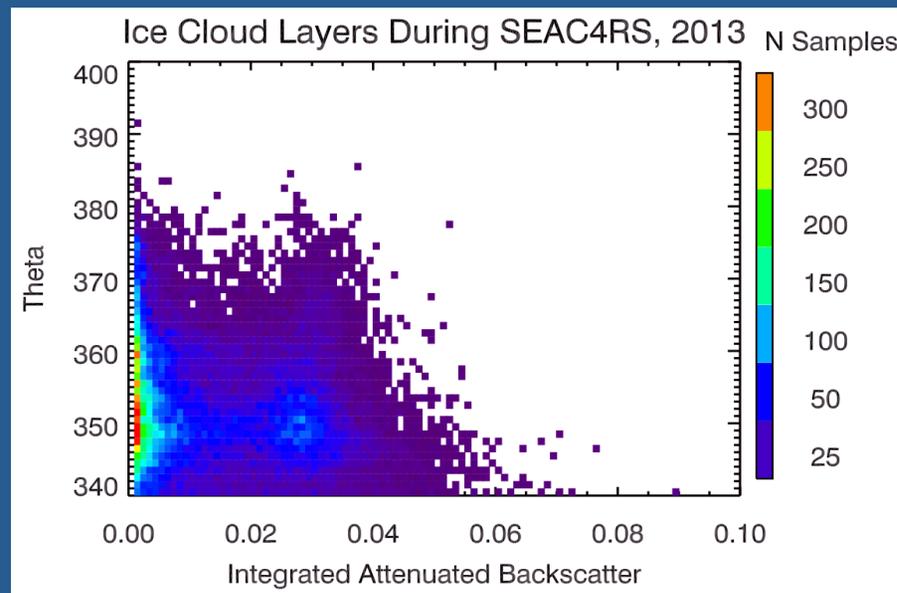
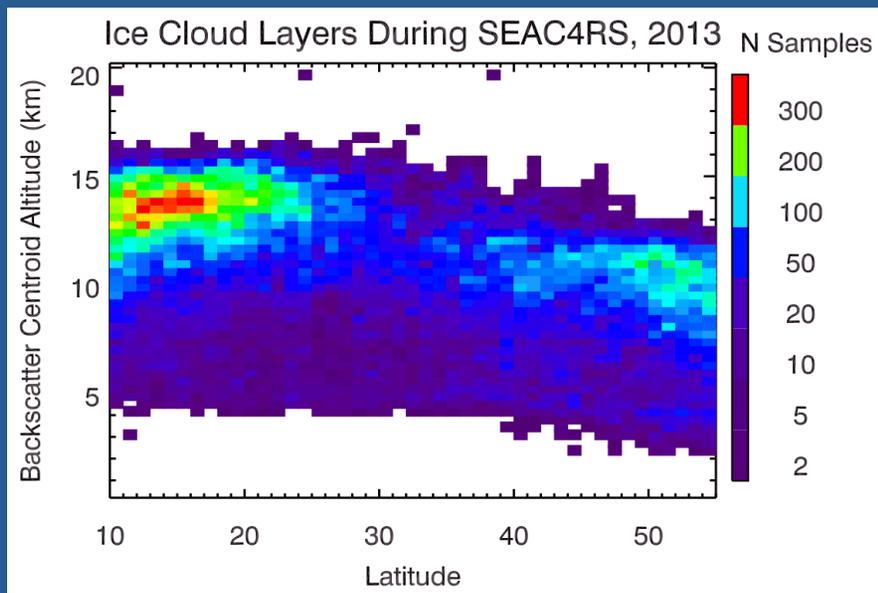
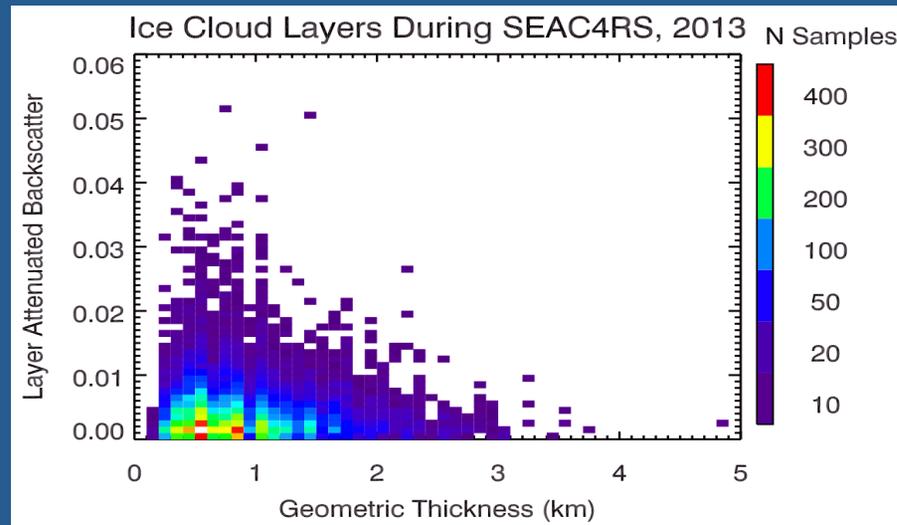
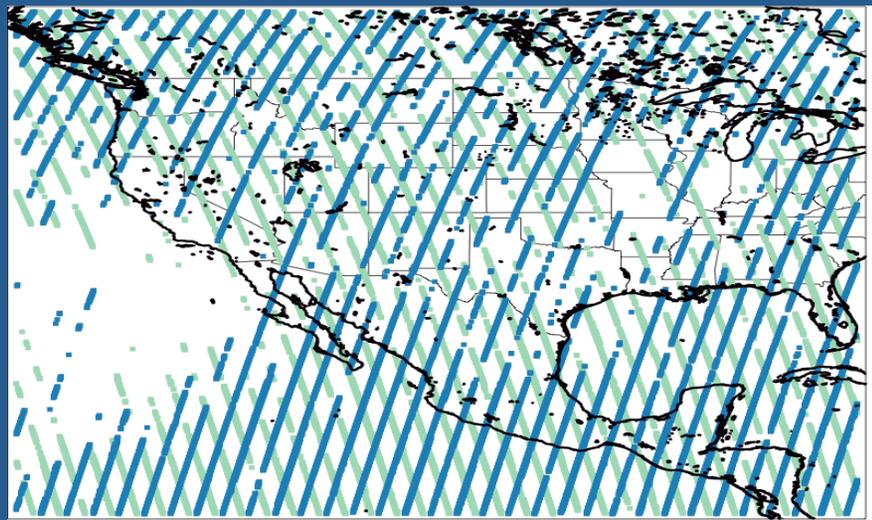
# CALIOP Ice Water Path August 22 – September 6, 2013



# CALIOP Ice Water Path September 7 – September 23, 2013

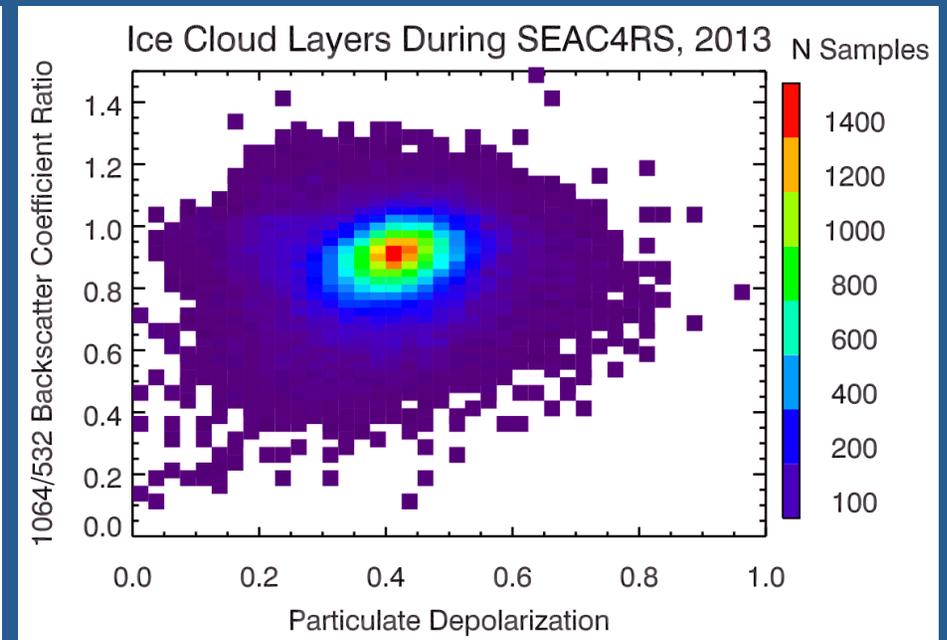
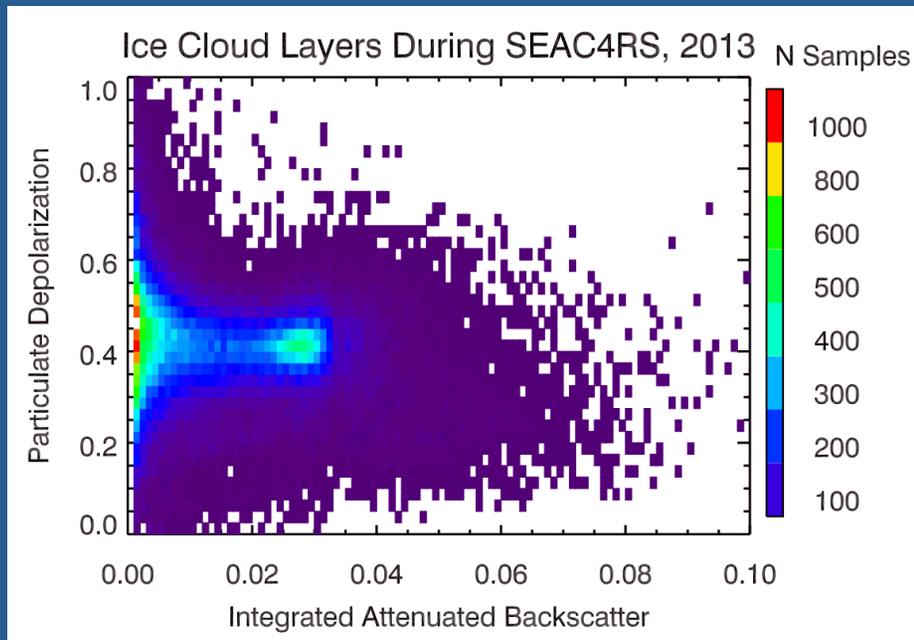


# Regional Cloud Ice Survey – “NAM”, August 6 – September 6



# SEAC4RS Ci Layers

## Particulate Depolarization and 1064/532 Color Ratio



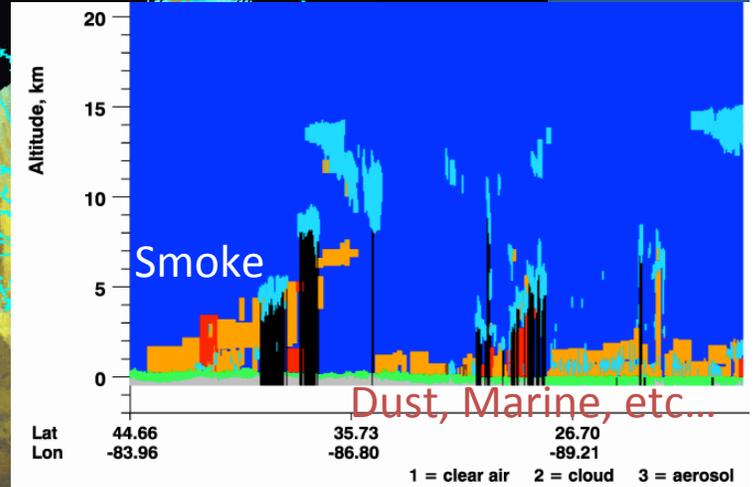
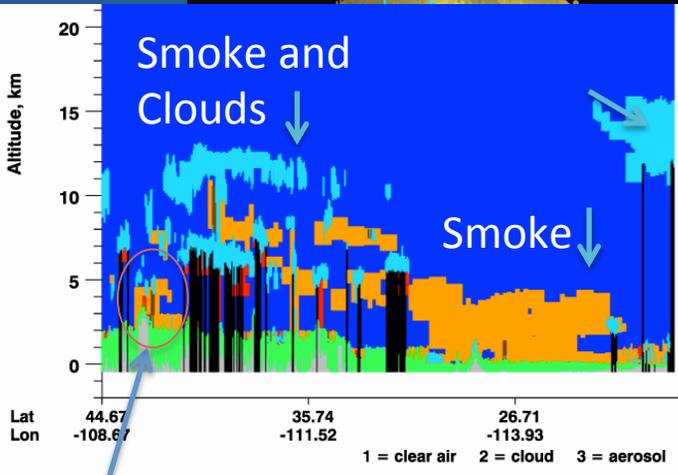
Depolarization vs  
Backscatter

Color Ratio vs  
Depolarization

# Smoke and Clouds - August 23

NASA Larc (M3.0)

Multichannel-**RGB**  
Aug 23, 2013 08:45 UTC

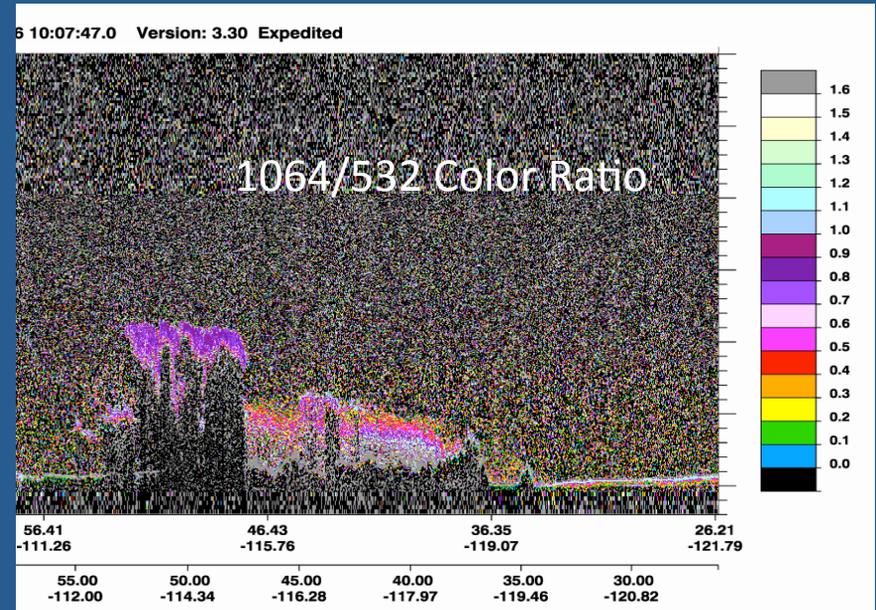
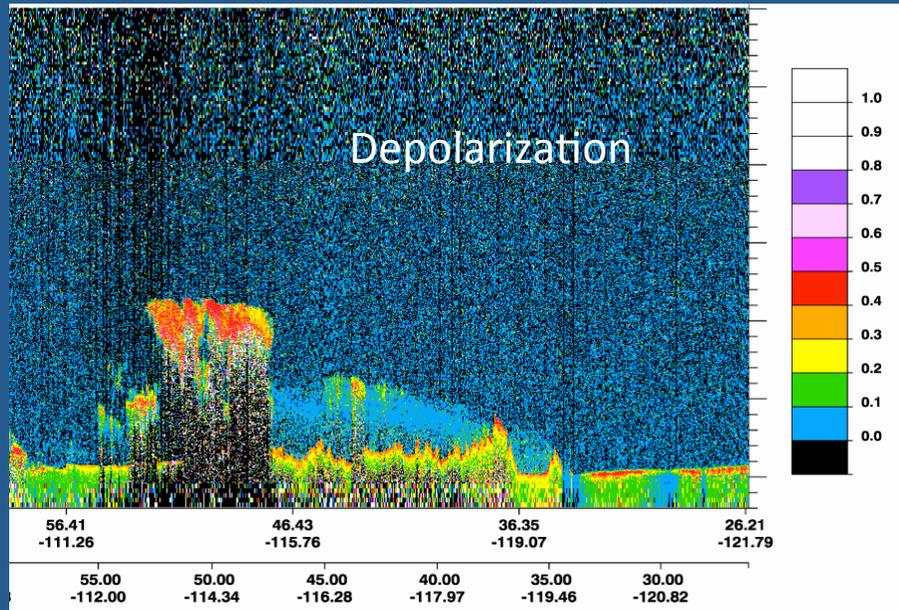
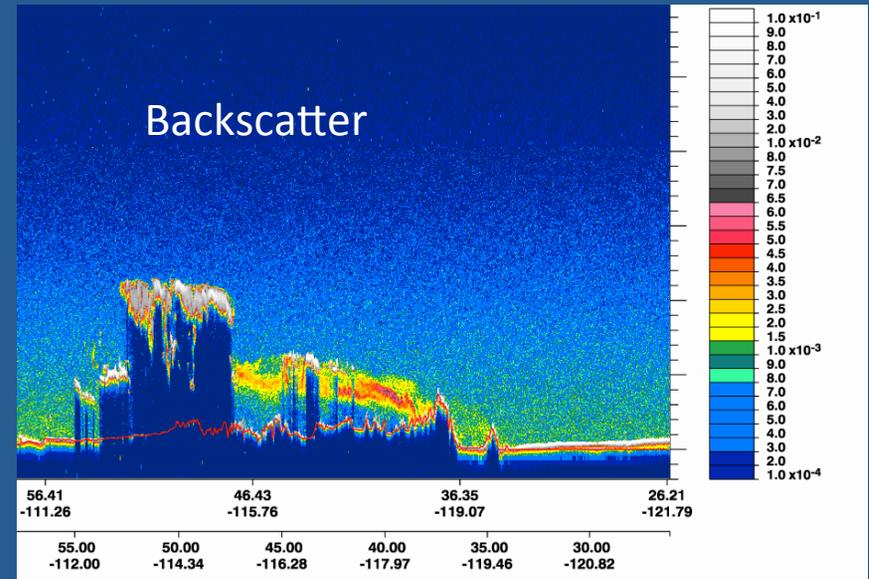
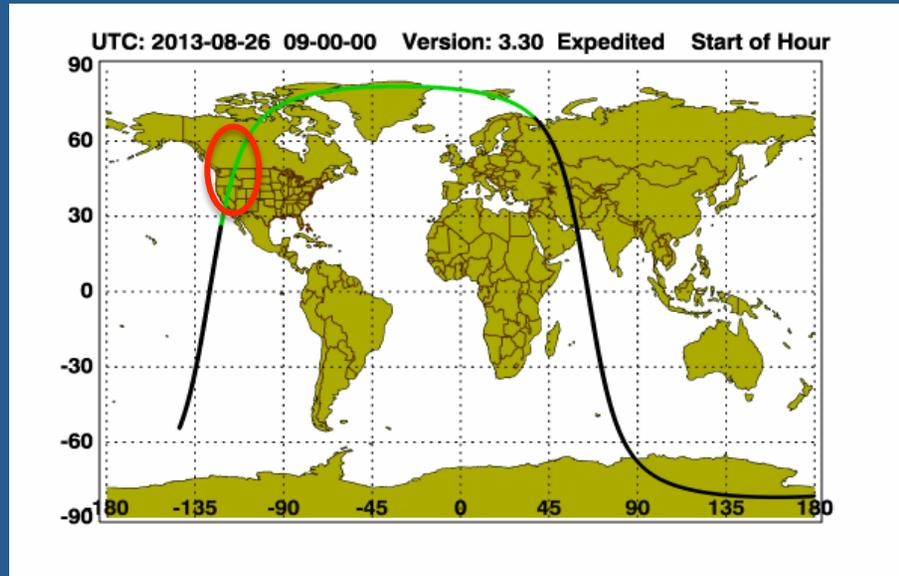


Somewhere  
near  
Bozeman?

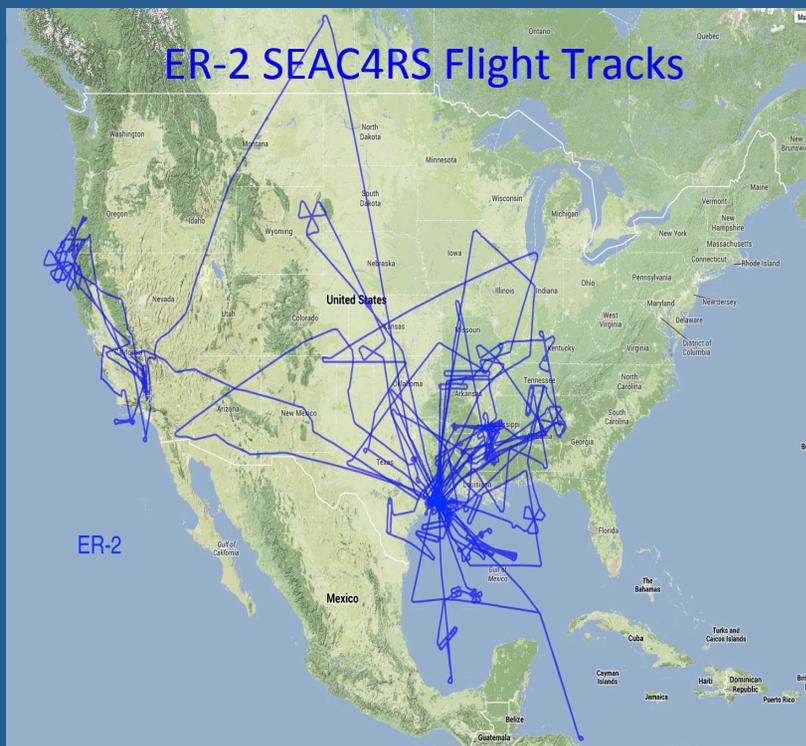
Cloud  
Aerosol

RGB GOES Composite – Minnis Group

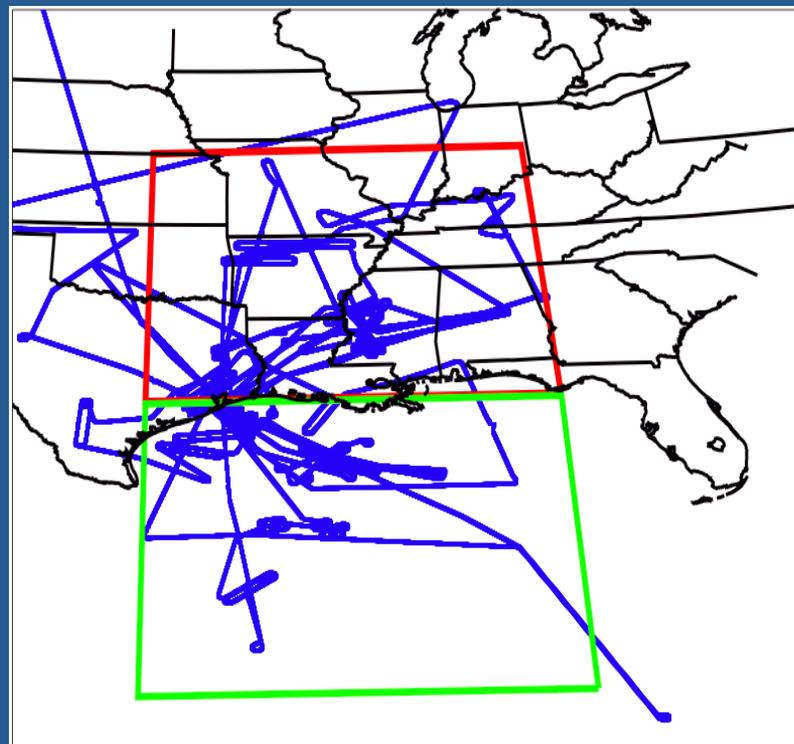
# CALIOP Observations of the RIM Fire ~9Z, August 26, 2013



# Compare CALIOP and FCDP Ice Cloud Particle Extinction Coefficients, August 27 – September 23

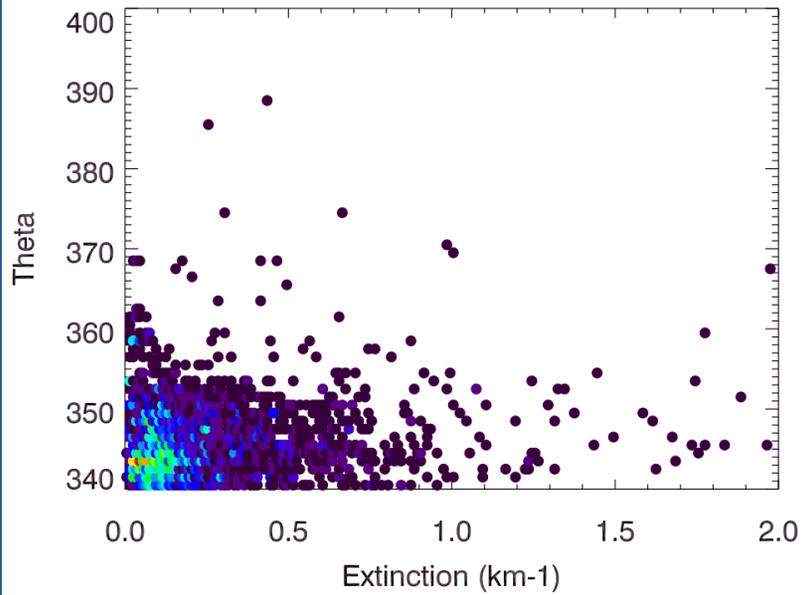


ER-2 Flight Tracks

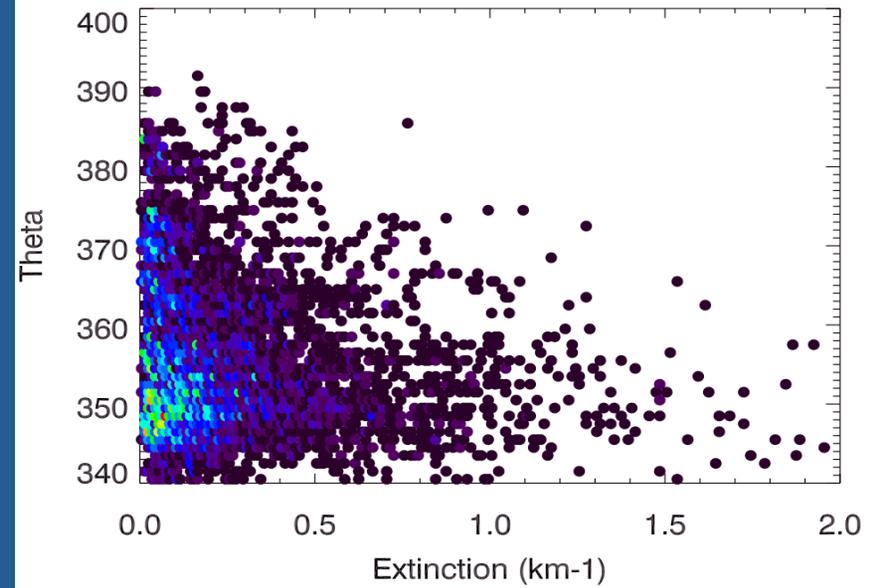


Continental (RED box) vs Marine (GREEN box) Ci.

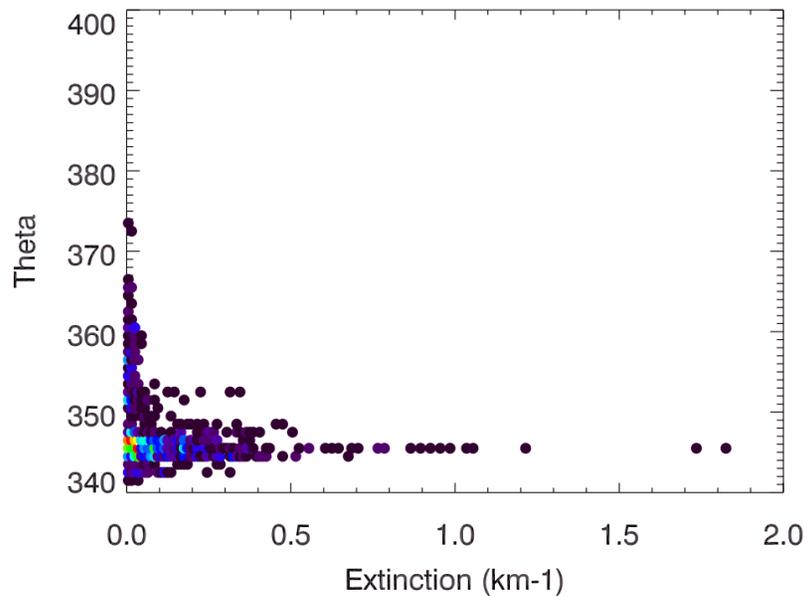
CALIOP Extinctions - Land



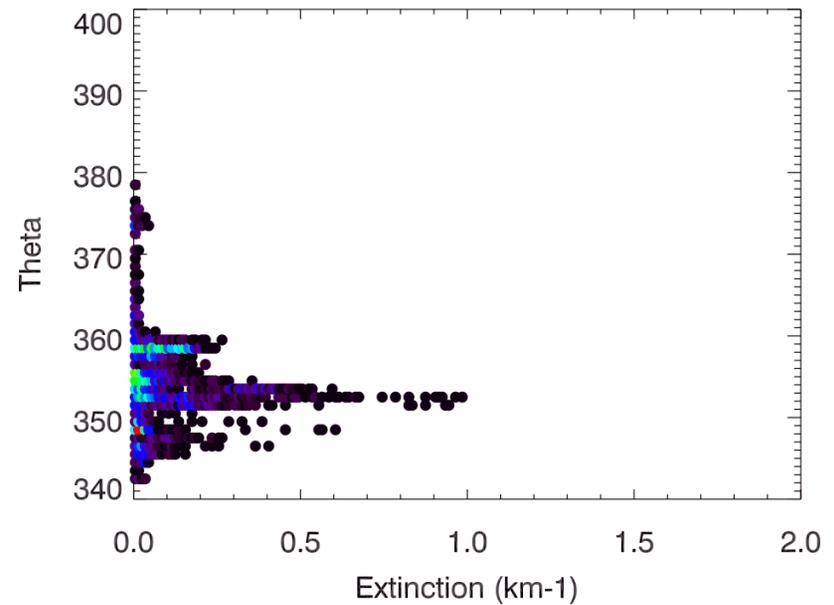
CALIOP Extinctions - Marine



FCDP Extinctions - Land



FCDP Extinctions - Marine



## Some Next Steps in the Analysis

- Compare results with the new, improved CALIOP Version 4 data set.
- Test the Heymsfield Extinction-IWC parameterizations with the SPEC CR-AVE data set.
- Fold the IIR microphysical parameter into the analysis. How does this correlate with the CPI particle habits?
- Explore whether there is a robust correlation between the ice particle asymmetry parameter and particulate depolarization.

## Take-Away Messages

- CALIPSO has been making measurements for nearly 8 years, globally – motivation for up-scaling relationships from aircraft field mission data to provide more impact of the data, globally.
- Lidar data shows that cloud ice extends above the GMAO tropopause to 18-19 km.
- Sub-visible cirrus depolarize like other Ci, at 40-60%. Particulate color ratio and depolarization do not appear to be correlated.
- Fresh smoke does not depolarize significantly, but mixed smoke and ice particles do. Within a smoke layer, the color ratio and depolarization can be anti-correlated.
- Continental and marine convection differences can be observed using elastic-backscatter lidar – more to follow.
- Much more can be learned from the rich and varied SEAC4RS data.